Ninth graders' energy-balance knowledge and physical activity behavior: An expectancy-value perspective

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Abstract:

Expectancy beliefs and task values are two essential motivators in physical education. This study was designed to identify the relation between the expectancy-value constructs (Eccles & Wigfield, 1995) and high school students' physical activity behavior as associated with their energy balance knowledge. High school students (N = 195) in two healthful-living programs (i.e., combination of physical and health education) responded to measures of expectancy-value motivation, energy balance knowledge, in-class physical activity, and after-school physical activity. The structural equation modeling confirmed positive impact from expectancy beliefs and interest value to in-class physical activity (Path coefficient range from .19 to .26, ps < .01). Cost perception was found exerting a negative impact on after-school physical activity but a positive one on lower level of understanding of energy balance (Path coefficient range from -.33 to -.39, ps < .01). The findings painted a complex but meaningful picture about the motivational impact of expectancy-value constructs on physical activity and energy balance knowledge. School healthful-living programs should create motivational environments that strengthen students' expectancy beliefs and interest value and alleviate their negative perceptions and experiences.

Keywords: motivation | learning | physical education

Article:

Positive energy imbalance leads to weight increase (Katz, 2011). In light of combating the youth obesity epidemic, children and adolescents should be encouraged to learn knowledge and behaviors for energy-balanced living (Camoes, Oliveira, & Lopes, 2011). Energy balance (EB), as an essential concept in relation to body weight change, is recently incorporated into the high school healthful-living curriculum, a course combining health education and physical education (PE) (Friedman, Stine, & Whalen, 2009). In this course, students are expected to gain a good understanding of EB and engage in behaviors that enable them to attain a balance between energy intake and expenditure.

Realization of this expectation relies in large part on students' willingness to learn the EB knowledge and behaviors. In other words, the outcome of this effort depends on students' motivation for learning. Motivation refers to the process whereby goal-oriented human behaviors are instigated and sustained (Pintrich & Schunk, 2002). Recent research evidence, as summarized in a meta-analysis (Chen, Chen, & Zhu, 2012), suggests that expectancy beliefs in success and task values are two effective motivators in K-12 PE. This study aimed to identify motivational influence of expectancy beliefs and task values on high school students' EB knowledge, in-class physical activity, and after-school activity. It is believed that examining motivation, EB knowledge in relation to moderate to vigorous physical activity (MVPA) has potential to provide specific evidence useful in guiding intervention programs for physical activity promotion and weight management.

The Expectancy-Value Theory

The expectancy-value theory consists of two major components: expectancy belief and task value (Eccles & Wigfield, 1995). *Expectancy belief* is defined as an individual's self-perception of success in an upcoming activity; while *task value* is defined as one's subjective reasons for doing or not doing an activity (Eccles & Wigfield, 1995). Prior research identified four distinct constructs of task values: attainment value, interest value, utility value, and cost across academic areas and PE (Eccles & Wigfield, 1995; Xiang, McBride, Guan & Solmon, 2003). Specifically, *attainment value* is the perceived importance of doing well in learning. The attainment value of PE is acknowledged in terms of content that students think it important to master. *Interest value* refers to the extent to which a learning experience is enjoyable or interesting. Much PE content (e.g., games) holds interest values and is recognized by K-12 students as efficacious to provide enjoyable experiences. *Utility value* is the perceived usefulness of learning tasks and experiences. Participating in MVPA in PE and beyond possesses the utility value for health. *Cost* refers to the expense or negative consequence of engaging in an activity. Cost perceptions may derive from a variety of factors such as physical discomfort, boredom, irrelevant curricula, and perceived incompetence (Chen & Liu, 2009; Xiang, McBride & Bruene, 2006).

Expectancy beliefs and task values have distinct motivational impact on various outcome variables. In one study, Xiang, McBride, and Bruene (2004) examined fourth graders' expectancy-value motivation and its relation to one-mile run performance and intention for future participation in running. It was found that interest value and attainment value positively predicted intention for future running; while expectancy beliefs facilitated the one-mile run performance. Using a similar approach, Gao (2008) examined engagement, satisfaction, and cardiovascular fitness performance in relation to expectancy-value motivation among sixth, seventh, and eighth grades. The findings indicated that expectancy beliefs predicted cardiovascular fitness performance; whereas expectancy beliefs, attainment value and interest value predicted engagement and satisfaction.

The impact of the expectancy-value motivation on learning outcomes (e.g., knowledge and skill acquisitions) in PE seems to be limited. In one study, Zhu and Chen (2010) involved 854 sixth, seventh, and eighth grade students who were *pre-* and *post*-measured on health-related fitness knowledge and badminton overhand striking skills. They found that the students demonstrated significant acquisition in health-related fitness knowledge and skills, but neither expectancy beliefs nor task values contributed to these learning achievements. In another study, researchers (Chen, Chen, Sun, & Zhu, in press) investigated the triadic relationships among expectancy-value motivation, health-related fitness knowledge, and in-class physical activity in an elementary school sample. The findings indicated that attainment value had a positive prediction to fitness knowledge when the knowledge perceived important was learned along with light to moderate physical activity.

In comparison with other expectancy-value constructs, cost has received relatively less research attention. As documented by prior research, cost is often measured by open-ended questions. A few researchers attempted to quantify students' reported cost for analysis (Chen & Liu, 2009; Xiang et al., 2006). Xiang et al. (2006) examined fourth graders' expectancy-value motivation in a running program. There was about one third of the students reported cost of some kind. The cost originated from sources such as physical discomfort, boredom, disliking of the content, and perceived incompetence. At the college level, Chen and Liu (2009) reported that college students perceived a variety of cost ranging from disappointment at the curriculum, learner-unfriendly learning context, irresponsible teachers, to de-contextualized assessments. These cost perceptions appeared to be de-motivators that undermined students' interest value in PE (Chen & Liu, 2009). Nevertheless, despite the negative impact, cost did not seem to offset students' overall motivation for enrolling with PE in the future (Chen & Liu, 2009).

EB Knowledge

EB knowledge refers to information that elaborates the scientific mechanism underlying EB as well as the outcomes of energy imbalance (Katz 2011). The knowledge includes concepts and principles about human body, nutrition, and physical activity. Maintaining a balance between energy intake and energy expenditure requires the individual to understand and distinguish the amount of calories that foods/beverages provide, the amount that basic metabolism requires, and the amount that a variety of physical activities demand.

The research on EB knowledge is sporadically documented. Longitudinal evidence that followed 111 students from fifth and sixth grade into eighth grade indicates that exercise knowledge, along with other variables, significantly predicting MVPA (DiLorenzo, Stucky-Ropp, Wal, & Gotham, 1998). Similarly, knowledge of nutrition has a positive association with fruit and vegetable intakes among children (Blanchette & Brug, 2005) and adolescents (Lytle et al., 2003); while increased knowledge of the dietary guidance was positively associated with more healthful eating patterns (Kolodinsky, Harvey-Berino, Berlin, Johnson, & Reynolds, 2007).

It was not until recently that research has collectively focused on knowledge of energy intake and energy expenditure. Slater et al. (2011) studied the association between home environment and EB knowledge among 349 youth/parent pairs. The paired EB knowledge (average of youth and parent knowledge scores) was positively associated with food availability, media equipment availability and accessibility, and activity-to-media ratio score (i.e., physical activity divided by media availability and accessibility). With more and better understanding of EB knowledge, the participants demonstrated healthier nutrition choices, less television or screen time, and more physical activity. The study recognized the importance of EB knowledge among both adolescents and their parents.

Further evidence also identified a positive association between EB knowledge and moderate physical activity and a negative association between EB knowledge and television-viewing (Nelson, Lytle, & Pasch, 2009). It was also pointed out that there were a substantial proportion of adolescents lacking EB knowledge and there was a strong need to improve adolescents' EB knowledge literacy in the backdrop of obesity crisis (Nelson et al., 2009). As a complex society issue, the obesity epidemic requires concerted efforts from schools, communities and families. Physical educators who are often health educators appear to be a main source of knowledge and skills adolescents need to overcome EB knowledge illiteracy.

The Present Study

Supported by prior research, expectancy beliefs, attainment, interest, and utility values turn out to be adaptive motivators for various outcomes in PE (Chen et al., in press; Gao, 2008; Xiang et al., 2004); while cost is a construct that undermines students' motivation (Chen & Liu, 2009; Xiang et al., 2006). However, little evidence is available to support how expectancy-value motivation influences learning outcomes such as EB knowledge and physical activity level. This study was designed to further examine the motivational impact of expectancy-value constructs through addressing the specific question: To what extent would expectancy-value constructs influence EB knowledge, in-class and after-school physical activity? It was hypothesized that expectancy beliefs, attainment value, interest value, and utility value would positively predict EB knowledge and physical activity. It was also hypothesized that cost, as a de-motivator, would undermine EB knowledge and physical activity. Further, the constructivist learning theory informs that the complex and relational understanding should be distinguished from the piecemealed, superficial understanding (Ennis, 2007). It would be necessary to discern the motivational effects of expectancy-value constructs on EB knowledge at these two distinct levels of understandings.

Method

Settings and Participants

Two high schools in a southeastern U.S. state were selected as the research settings. In both schools the EB knowledge was taught to ninth graders before data collection of this study. The two schools shared similar characteristics on four key variables: race/ethnicity (~40% Caucasian), ratio of students eligible for free or reduced lunch program (~40%), school size (> 1,400), and pupil/teacher ratio (~15:1). One credit of the required healthful living course that combined physical and health education (but taught separately) was required for graduation. The teachers of the course were certified to teach both PE and health, and had a wide range of teaching experiences (from seven to 28 years). Physical education was centered on sport-based content. Students were exposed to a different sport in every two weeks. A typical PE class started with warm-up routines (e.g., calisthenics, running or walking in laps, and/or stretching) and then proceeded to game play. The health classes were delivered in classroom-based lectures. The health content including EB knowledge revolved around a textbook required by the state (Friedman et al., 2009).

The study involved 195 ninth grade students from 12 classes in the two schools. It is of great importance to understand ninth grade students' motivation level, knowledge competence, and physical activity level because ninth grade is the last year of mandatory PE in the state. It was predicted that the majority of high school students would not take PE beyond this point. The sample consisted of more girls (n = 115) than boys (n = 80). Race/ethnicity data associated with minorities were collected but were not approved by the school district for dissemination in any publications, hence not reported here. All participants submitted written parent/guardian consents and assents. The study was approved by the Institutional Review Board and the participating school district before data collection and supported by the teachers and their school principals.

Measurements

Expectancy-Value Constructs. The *Expectancy-Value Questionnaire* (EVQ) was used to measure expectancy-value constructs (Eccles & Wigfield, 1995; Xiang et al., 2003). Five items measured expectancy beliefs. For example, "How good are you in PE?" (1 = *not good*, 5 = *very good*). Six items measured task values with two items for each construct. For example, an item for attainment value was "Compare to math, reading, and science, how important is it for you to learn PE?" (1 = *not very important*, 5 = *very important*). Two open-ended items measured cost in PE. They were "If there is anything you do not like in PE, what would that be? Why?" and "If you had a choice, would you rather not come to PE? Why?" The EVQ demonstrated high construct validity and test retest reliability in previous research (Xiang et al., 2003; Zhu et al., 2012).

EB Knowledge. In the health education textbook, EB knowledge was represented and highlighted by 16 major concepts (Friedman et al., 2009): Beverage, Calorie, Carbohydrate, Energy Balance, Energy Expenditure, Energy Intake, Fat, Food, Metabolism, Obesity, Weight Increase, Weight Loss, P.E., Physical Activity, Physical Inactivity, and Protein. To measure students' EB knowledge, concept mapping techniques were used to reveal the knowledge structure. Consistent with previous research (McClure, Sonak, & Suen, 1999; Novak, 2005), a mapping protocol was created for participants to (a) cluster relevant concepts and (b) link the concepts in pairs and label propositions for identified relations. The protocol generated data for two variables: concept clusters and concept propositions that represented the lower-level and the higher-level of knowledge, respectively (Novak, 2005). Specifically, a concept cluster refers to concepts grouped together that potentially assume an intragroup conceptual relation; while a concept proposition refers to a relation between every two concepts whose relational meaning is specified with a labeled explanation. The mapping protocol was piloted with a nonparticipating ninth grade class (n = 30) before being applied to the participants. The data from the pilot demonstrated that (a) students at this grade level did not have difficulties in understanding the EB concepts as independent entities, and (b) they were able to follow the concept-mapping protocols with cognitive concentration for no less than 30 min. Previous research confirmed that concept-mapping is a valid and reliable approach to measuring learners' knowledge structure (Novak, 2005).

In-Class Physical Activity. In-class physical activity was measured using the ActiGraph GT3× accelerometers (ActiGraph, Shalimar, FL). The device records physical activity counts in three physical planes. The ActiGraph GT3× accelerometer has demonstrated outstanding criterion validity and reliability in previous research (Melanson & Freedson, 1995).

After-School Physical Activity. The *Three-Day Physical Activity Recall (3DPAR)* was used to measure after-school physical activity (Weston, Petosa, & Pate, 1997). The instrument provided a grid divided into 15-min segments where participants recalled their activities occurred between 3:00 and 10:00 p.m. The recalled activities were classified into seven categories: sport, fitness, other physical activity, academic/homework, rest, entertainment, and socialization. For each 15-min segment, the main activity that occupied most of the 15-min period was entered. The instrument demonstrated good concurrent validity and test-retest reliability (Trost, 2001; Weston et al., 1997).

Data Collection

Data were collected in a planned sequence: EVQ, concept-mapping, accelerometer, and 3DPAR. The students first self-reported on the EVQ independently in a regular health or PE lesson with the teachers' permission and assistance. The procedure lasted for approximately five minutes. Then, they proceeded to creating concept maps. Concept-mapping lasted for 30–40 min that began with a trial session using four categories of dog concepts (i.e., breed, body parts, sound, & behavior). The trial session was administered to familiarize students with the mapping techniques and the mapping procedures. During the trial session, all questions about concept-mapping techniques and requirements were addressed. In the subsequent mapping of the 16 EB concepts students were all clear about the procedures and were able to concentrate on the mapping task without unnecessary interruption due to unfamiliarity of the procedures. Within two weeks after concept-mapping, the students wore the accelerometers during physical education to measure their in-class physical activity in two randomly chosen nonconsecutive PE lessons. To control the effect of reactivity (Heppner, Wampold, & Kivlighan, 2008), a trial lesson was arranged before the two data collection lessons for students to become accustomed to the feeling of wearing the accelerometer. Lastly, the students were instructed on how to document and recall their after-school activity. They recalled their activity type and time on two regular week days and one weekend day.

Data Reduction

Students' responses to the 11 5-point Likert items of the EVQ (i.e., expectancy beliefs, attainment, interest, and utility value) were aggregated by construct. The students' responses to the two open-ended questions for cost were quantified based on a validated rubric shown in Table 1. The rubric was created and deliberated by an expert panel of four pedagogy researchers who demonstrated knowledge of the expectancy-value theory and expertise in measurement in their previous research. The Delphi technique (Linstone & Turoff, 2002) was used in the deliberation to arrive at a 100% agreed rubric solution for scoring.

As shown in Table 1, the rubric included (a) number and degree of cost reported, (b) intention for future PE and (c) composite EVQ score. The number of cost refers to the number of reasons students cited as the cost of their participating in physical education. The degree of cost was defined as a negative motivation consequence associated with cost reasons. A response with strong emotions (e.g., frustration, dislike) reflected high motivation consequence; while no or weak emotions reflected low motivation consequence. Moreover, composite EVQ score was included in the rubric to reflect the theoretical integrity of the expectancy-value theory where cost is considered a component mediating expectancy-value motivation. This score was calculated by averaging a student's scores of expectancy beliefs, attainment, interest and utility values.

Table 1. Rubrics for Calculating Overall Cost Scores

(a) Number and Degree of Cost Reported:		
0	No or low cost	0–1 reason & no or low motivation consequence
1	Moderate cost	2 reasons & low motivation consequence
2	High cost	2+ reasons & high motivation consequence
(b) Intention for Future PE:		
0	No or low cost	Positive intention
1	Moderate cost	"It depends"
2	High cost	Negative intention
(c) Composite EVQ Score		
0	No or low cost	> 4.0
1	Moderate cost	3.0–4.0
2	High cost	<.3.0
Overall Cost Perception Continuum Scale		
0	(No or low cost) ——————————— 1	(Moderate cost) ———————— 2 (High cost)

The following illustrates how one female student's responses to the two open-ended questions were quantified and her overall cost score was computed. First, when this female student responded to the question, "If there is anything you do not like in PE, what would that be? Why?" she wrote, "I don't like how we have to run the track every day because I get worn out and then don't want to do it anymore. I also don't like the fact that we are graded based on physical ability rather than if you try. Some people are better than others, and it can be frustrating to actually participate when you're not good at it." Based on the rubric shown in Table 1, this student had a score of 2 for the Number and Degree of Cost Reported as she cited two reasons as cost (i.e., boring course content and inappropriate assessment method) and associated high motivation consequences (i.e., get worn out and then don't want to do it anymore, be frustrating to actually participate). Second, when responding to the question, "If you had a choice, would you rather not come to PE? Why?" she replied, "Yes, I would go [to PE] to get fit, and stay in shape." Her score for the Intention for future PE was 0 as she indicated she would continue to participate in physical education, which reflects low cost impact. Finally, this student had a composite expectancy-value motivation score of 3.48, resulting in a score of 1 for the Composite EVQ Score. Consequently, her overall cost score was (2+0+1)/3 = 1. Placing this score on the 0–2 continuum scale, it showed that this female student had moderate cost perception.

Concept maps were scored in reference to two scientifically correct master concept maps and a rubric created and validated by the expert panel. The Appendix shows the two master concept maps and Table 2 illustrates the validated rubric. According to the rubric, the correctness of concept clusters and concept propositions were judged and quantified into four levels of performance (0 = low performance; 3 = high performance). One researcher scored the students' concept maps independently by referring to the two master maps and the rubric.

In-class physical activity counts were converted into counts/minute to represent the level of intensity for in-class physical activity. Sasaki, John and Freedson's (2010) thresholds were adopted to categorize levels of intensity (light: count < 1952; moderate: 1953–5724; high: 5725–9498; very high: > 9498). After-school activity data were reduced into minutes of MVPA. Referring to the recent compendium of physical activity and MET values, each type of recalled activity was coded into MET values (Ainsworth et al. 2011). Physical activities with MET larger than 3 were converted into MVPA.

Table 2. Rubrics for Scoring Concept Maps

Score	Concept clusters	Concept propositions
0	Blank or 0 correctly clustered concepts	Blank or 0 correctly connected proposition
1	1–4 correctly clustered concepts	1–4 correctly connected propositions
2	5–8 correctly clustered concepts	5–8 correctly connected propositions
3	9+ correctly clustered concepts	9+ correctly connected propositions

Data Analysis

Validity and reliability of the measurements were calculated before data analysis. Intrarater reliability coefficients for coding/scoring cost and concept maps were calculated to reflect objectivity and reliability. The researcher scored and rescored with a one-day interval a randomly chosen 25% of the cost responses and the concept maps. Two separate Pearson product-moment correlation analyses were conducted to obtain the intrarater reliability coefficients. Internal consistency of the expectancy-value constructs (Cronbach's α) were calculated; while structural reliability for each construct were obtained using confirmatory factor analysis on LISREL 8.8. The data were tested for potential violations of statistical assumptions. These tests were operated on PRELIS, a built-in software of LISREL8.8.

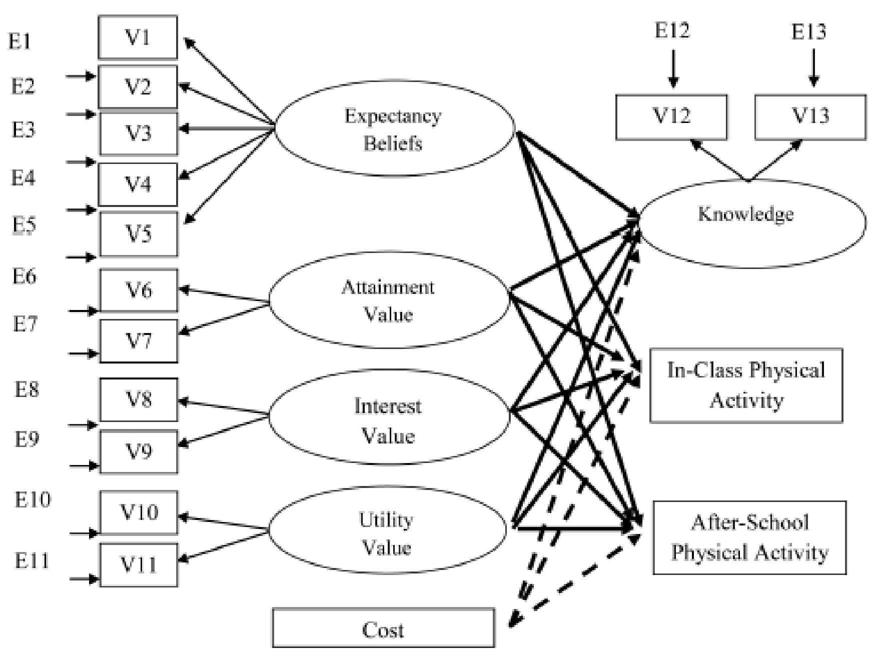

Figure 1. The a priori Structural Model for Analysis.

The a priori model, shown in Figure 1, was analyzed by testing the paths from expectancy-value constructs to EB knowledge, in-class physical activity, and after-school physical activity. The structural equation modeling (*SEM*) was used to test this model and its competing models. Three competing models of the full model were generated on the basis of two rationales: (a) To analyze EB knowledge as a latent variable and as two observed variables (i.e., concept clusters and concept propositions), and (b) to generate the more parsimonious models based on suggestions of the modification indices. LISREL 8.8 was employed for the *SEM* analyses. Chi-square ($p > .05$), root mean square error of approximation (RMSEA < .06; Browne & Cudeck, 1993), comparative fit index (CFI > .95; Bentler, 1990), and goodness of fit index (GFI > .90; Joreskog & Sorbom, 1989) were the model fit indices used for testing. Full information maximum likelihood estimation was used to address missing data (Enders, 2009).

Results

Pearson correlation analyses revealed high intrarater reliability for "Cost in PE" ($r = .94$), "Concept Clusters" ($r = .90$), and "Concept Propositions" ($r = .90$), indicating that the researcher's scoring process remained consistent and reliable. The EVQ demonstrated satisfactory construct validity (Cronbach α ranging from .76 to .84). Factor loadings for the four expectancy-value constructs were acceptable (expectancy beliefs: λ = .85, .81, .68, .58, .67; attainment value: λ = .78, .79; interest value: λ = .80, .91; utility value: λ = .77, .85).

Table 3. Descriptive and Correlational Information of the Variables

Variable	*N*	*M*	*SD*	Range	EB	AV	IV	UV	Cost	CC	CP	IPA	APA
EB	167	4.07	.70	1–5	1								
AV	169	3.43	1.13	1–5	.36**	1							
IV	171	3.67	1.07	1–5	.24**	.38**	1						
UV	170	3.58	1.01	1–5	.32**	.58**	.48**	1					
Cost	165	.67	.55	0–2	-.41**	-.57**	-.59**	-.55**	1				
CC	173	2.35	.81	0–3	-.10	-.14	-.04	-.12	.23**	1			
CP	173	1.10	1.16	0–3	-.07	-.11	-.11	-.15*	.13	.36**	1		
IPA	190	1890	604	—	.32**	.16*	.24**	.22**	-.27**	-.00	.02	1	
APA	195	79.03	62.37	—	.16*	.09	.11	.21**	-.34**	-.04	-.06	.19**	1

Note. EB = Expectancy beliefs; IV = Interest value; CPE = Cost in PE; IPA = In-class physical activity; CC = Concept cluster; APA = After-school physical activity. The unit of in-class physical activity is counts/minute; The unit for after-school physical activity is minute. $*p < .05$; $**p < .01$.

Table 3 reports the descriptive and correlational results for expectancy-value constructs, EB knowledge, in-class physical activity, and after-school physical activity. The participants reported relatively high expectancy beliefs, attainment value, interest value, and utility value (ranging from 3.43 ± 1.13 for attainment value to 4.07 ±.70 for expectancy beliefs), but low cost (.67 ± .55). EB knowledge score was moderate where performance for concept clusters was approximately twice as high as that for concept propositions. The students participated in light to moderate in-class physical activity (1890 ± 604 counts/minute), and spent more than an hour per day (79.03 ± 62.37 min) on MVPA after school. All variables appeared to have skewness and kurtosis values falling between or close to -1–1, showing roughly normal distributions.

Expectancy beliefs and task values positively correlated with each other and with in-class physical activity but negatively correlated with cost. Expectancy beliefs and utility value positively correlated with after-school physical activity; cost negatively correlated with both in-class and after-school physical activity.

Table 4 shows the statistically significant paths tested by *SEM*. Specifically, Model 1 tested the original a priori model (Figure 1) in which expectancy beliefs, attainment, interest, and utility value were hypothesized to positively predict EB knowledge (as a latent factor), in-class physical activity, and after-school physical activity; while cost negatively predict these outcome variables. The results revealed that expectancy beliefs positively predicted in-class physical activity ($p < .01$), and that cost in PE negatively affected after-school physical activity ($p < .01$).

Table 4. Statistically Significant Paths for the Four Competing Structural Equation Models

Path origin	Path end	Model 1	Model 2	Model 3	Model 4
EB	IPA	.24**	.26**	.24**	.24**
IV	IPA		.19**		
CPE	CC			.26*	.25**
CPE	APA	-.38**	-.33**	-.38**	-.39**

Note. EB = Expectancy beliefs; IV = Interest value; CPE = Cost in PE; IPA = In-class physical activity; CC = Concept cluster; APA = After-school physical activity; $^{*}p < .05$; $^{**}p < .01$.

Because Model 1 was statistically saturated; it required modification. Based on the modification indices from LISREL output, Model 2, a reduced model from Model 1, tested paths from expectancy beliefs and interest value to in-class physical activity, and the paths from attainment value, interest value, and cost in PE to after-school physical activity. Model 2, as a more parsimonious model demonstrated outstanding model fit indices (χ^2_{13}= 14.90, $p = .31$; RMSEA = .03, 90% Confidence interval: .00, .08, $p = .70$; SRMR = .06). Expectancy beliefs ($p < .01$), and interest value ($p < .01$) were found positively predicting in-class physical activity; while cost in PE negatively predicting after-school physical activity ($p < .01$).

Further, as informed by previous theoretical articulation (e.g., Ennis, 2007), it was necessary to discern the motivational effects of expectancy-value constructs on EB knowledge at two distinct levels of understandings. Driven by this rationale, Model 3 and Model 4 were therefore specified and tested.

Similar to Model 1 results, Model 3 identified the significant path from expectancy beliefs to in-class physical activity ($p < .01$) and path from cost in PE to after-school physical activity ($p < .01$). It further identified the significant path from cost in PE to concept clusters ($p < .05$). Nevertheless, Model 3 was statistically saturated and required model modification. Based on modification indices from LISREL, Model 4 was specified and tested.

Model 4 tested the hypothesized paths from expectancy beliefs, interest value, and cost in PE to in-class physical activity, the paths from interest value and cost in PE to concept clusters, and the paths from attainment value, interest value, utility value, and cost in PE to after-school physical activity. Model 4 demonstrated outstanding model fit (χ^2_{14}= 7.46, $p = .91$; RMSEA = .00, 90% confidence interval: .00, .03, $p = .99$; SRMR = .04). Similar to Model 2, Model 4 confirmed the positive impact of expectancy beliefs ($p < .01$) on in-class physical activity and the negative impact of cost in PE on after-school physical activity ($p < .01$). Further, different from Model 2, Model 4 revealed an unexpected positive effect of cost in PE on concept clusters ($p < .01$). It did not detect a significant path from interest value to in-class physical activity ($p > .05$).

Discussion

This study was designed to examine the extent to which expectancy-value motivation influenced EB knowledge, in-class physical activity, and after-school physical activity among ninth graders. The study revealed that expectancy beliefs and interest value facilitated in-class physical activity, cost in PE undermined after-school physical activity but positively predicted concept clusters. The findings painted a complex picture about the motivational impact of expectancy-value constructs on EB knowledge and physical activity.

Learning EB Knowledge and the Role of Motivation

An important finding of this study is that the ninth graders demonstrated difficulty in explaining the relationships among the EB concepts. The low scores in concept propositions indicate that the students did not capture the holistic and deep meaning of the EB knowledge, let alone applying this knowledge to regulate their behaviors relevant to obesity/overweight management (e.g., healthy eating and regular exercise). The inadequate EB knowledge might be related to its detachment to expectancy-value motivation. The data of this study showed that none of the expectancy-value constructs statistically impacted EB knowledge (ps > .05). The finding verifies other researchers' observation that motivation is rarely found associated with competence-based learning outcomes (e.g., fitness knowledge and badminton skill) in PE (Chen et al., 2012; Zhu & Chen, 2010). It further unveils the content focus of many contemporary PE and health programs; that is, it seems that the tradition of teaching PE and health in separation has been entrenched for decades. While EB knowledge was taught and learned in lecture-based health classes; physical activity as a behavior that is highly relevant to EB knowledge was exposed to the students as if it was a totally different content with distinct educational purpose. This separation might have prepared an environment that channels expectancy-value motivation toward physical engagement, not toward learning knowledge or cognitive tasks.

An unexpected finding of the study is that cost perceived in PE led to the students' performance of clustering EB concepts—a lower level of understanding. That is, as the students' negative perceptions increases in PE classes; they tend to increase their performance in learning EB knowledge in health classes. While locating the cause for this positive prediction went beyond the efficacy of this study; it is speculated that the students might have shifted their attention to learning the EB knowledge after having gained a variety of negative perceptions or experiences in PE. In this regard, the students might have felt it more rewarding to devote their motivational energy toward learning the EB concepts than to energize for physical tasks in the PE classes. Further research is needed to examine the linkage between cost and EB knowledge.

Motivation for In-Class Physical Activity

Motivation is pivotal for students' behaviors in PE (Chen & Ennis, 2009; Chen & Hancock, 2006). In this study, expectancy beliefs and interest value were found significantly contributing to in-class physical activity. More specifically, the ninth graders seemed to be motivated to participate in in-class physical activity by gauging the likelihood of success and the level of enjoyment. In theory, gauging the likelihood of success is attached to the learners' perceptions of competence and control associated with the learning activity (Schunk & Zimmerman, 2006). First, a learning task that is perceived falling within one's ability and control signals to the learner that they have the chance to attain success. In PE, students' perceived competence turns out to be a more important factor than actual competence as a motivator for engagement and learning. It has been identified by prior research as one of the strongest correlates of MVPA (Wallhead & Buckworth, 2004). Second, another influential factor that has helped bridged expectancy beliefs with in-class physical activity is perceived control. It is well documented that secondary school students become motivated when they believe they could control some aspects of the learning process and outcome (e.g., Ennis et al., 1999). The findings confirmed the positive linkage between expectancy beliefs and in-class physical activity. As observed by the researchers, the ninth grade students were exposed to a variety of sports or physical activities. The "exposure" model did not set up high expectations on performance/achievement but offered great autonomy for the students to partake in the activities.

Enjoyable learning experiences are motivational in nature (O'Reilly, Tompkins, & Gallant, 2001; Shen, Chen, & Guan, 2007). In this study, the ninth graders recognized the interest values of their PE. More importantly, this recognition in turn energized them to actively participate in the physical activities that were offered to them in PE. This finding verifies the previous research result that enjoyable experience is one of the most salient motivators in PE (O'Reilly et al., 2001; Shen et al., 2007). PE and health professionals are recommended to design and implement learning tasks that are accomplishable and enjoyable.

In comparison, the attainment value, utility value, and cost did not significantly impact in-class physical activity. As shown in Table 1, the students reported relatively lower scores on attainment value and utility value than expectancy beliefs and interest values. These findings indicate that ninth grade students tend to appreciate the opportunity of attaining success and having enjoyable experiences in PE classes. Although they also recognize the importance and usefulness of PE, it seems that they have developed a relatively mature, rational mindset that urges them to pursue successful and positive experiences. In addition, the level of cost appeared to be too low to mitigate their in-class physical activity level. While the traditional "multi-activity" curriculum has been criticized for not promoting student learning (Metzler, 2011); the negative experiences and perceptions seem to be manageable for the students in class.

Motivation for After-School Physical Activity

Motivating students to regularly and voluntarily exercise beyond school is a desirable goal of PE (Chen & Hancock, 2006; Ennis, 2010). It is supported that motivation nurtured in PE could carry over to leisure time and motivate students to engage in MVPA on their own (Cox, Smith, & Williams, 2008). However, little research has addressed the carry-over effect of negative perceptions or experiences derived from PE classes on after-school physical activity. Perceived cost in PE is assorted and multidimensional. Researchers unraveled that cost might originate from pedagogical sources (e.g., perceptions of boring curricula, incompetent teachers), social environment (e.g., intimidating peers), personal experiences (e.g., physical discomfort), or dispositional factors (e.g., low self-efficacy; Chen & Liu, 2009; Xiang et al., 2006). While being perceived, cost would function as a de-motivator that undermines or offsets students' motivation (Chen & Liu, 2009). In this study, although the ninth graders' cost perception was overall low (.67±.55) and did not impact in-class physical activity, it significantly de-motivated them to partake in leisure-time physical activity after school. This finding is instrumental and alerts PE professionals to take students' negative experiences and perceptions seriously with a sustainability vision. PE teachers should be sensitive about the drawbacks or barriers that may reside in their learning environments or instructions. If not addressed in a timely and appropriate manner, these drawbacks or barriers would carry over to settings beyond PE and compromise youth physical activity in a long run.

None of the other expectancy-value constructs showed significant impact on after-school physical activity level among the ninth graders. This finding points out the difficulty and challenge of promoting youth physical activity. In a review, Wallhead and Buckworth (2004) summarized that the "promotion of youth physical activity is a complex task (p. 296)" and successful PE-based physical activity promotion programs are only a few. The success largely relies on the nature of the activities (e.g., enjoyment, competence-focused) and the pedagogy that promotes students' psychological determinants (e.g., perceived competence and self-determination) of student motivation (Wallhead & Buckworth, 2004). To leverage the role of school PE in promoting youth physical activity, future research should adopt an integrative perspective on learner motivation and its relation to learning outcomes.

Conclusion

Taken together, expectancy beliefs and interest value positively impacted the ninth graders' in-class physical activity; cost perceived in PE undermined after-school physical activity but increased their performance in clustering EB concepts. Evidently, the expectancy-value theory (Eccles & Wigfield, 1995) is an informative theoretical perspective to address EB knowledge and physical activity behaviors. PE is an important venue to educate students with the necessary knowledge, skills, behaviors, and disposition so that they can become physically active on their own (Ennis, 2010). School personnel are encouraged to bridge the separation between PE and health curricula so that adolescents could make sense of the essential healthful-living knowledge (e.g., EB knowledge) through lived experiences (Moje et al., 2004). School-based physical activity promotion programs should create educational environments that could strengthen students' expectancy beliefs and interest value as well as alleviate their negative perceptions/experiences. Future research is needed to create and expand the systematic knowledge about the relations among expectancy-value motivation, healthful-living knowledge, and physical activity level.

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